ENEMY DEFLECTION AND DRIFT DRUM, AND THE REDUCED CHARGE CHANGE-OVER MECHANISM

Plate 4

121. **Deflection due to target speed across the line of fire** from the blue lattice in Plate 1, determines the position of the sliding pointer, blue, in this plate. This deflection is corrected for range and combined with a correction for drift at the range in use by being read from the drum, green, which is rotated by gun range.

With the change-over mechanism to full charge

122. **Gun range,** from Plate 3, enters by the coupling, green, and through the bevel gear and spline revolves the red clutch. Wheel (A) then drives the vertical spindle whose worm and wormwheel revolve the drum to gun range.

At the same time the mauve pinion (C) driven by the red clutch with which it is engaged drives pinion (D) whose shaft through bevel gear drives—

(i) the lead screw of the stop gear. When the nut on this gear reaches either of its limits any further movement causes a partial rotation of the pale yellow rocker. This action through the toothed segments on the right operates the ratchet mechanism and prevents any further movement of the range tuning or spotting drive in the direction in which the stop came into operation ;

(ii) through the continuation of the lead screw of the stop gear, and the coupling shown, to the cam in Plate 2, which lifts the generating roller off the topmost ball at the high and low limits of range ;

(iii) gun range to the range to elevation unit in Plate 5.

123. The lining up position is zero range ;

The F.C.–R.C. change-over mechanism is shown in the F.C. position in the plate. The spline clutch, red, which carries wheels A and B is operated by the red clutch lever.

For reduced charge firing

124. To operate the charge change lever the key, which will be found on the inside of the constant speed motor cover plate, is inserted in the square hole of the red spindle. By pushing in and turning the key, the spline clutch, red, disengages wheel " A " and engages wheel " B " with the vertical spindle, green, and revolves the drum as in F.C. but in the opposite direction. At the same time the spline clutch, red, is disengaged from wheel " C " and engaged at " E."

125. Two sets of curves are engraved on the deflection and drift drum, one set for full charge and one for reduced charge. The gearing is so arranged that when the charge change clutch is in the full charge position the drum will revolve in the direction to expose the full charge curves, and when in the reduced charge position the drum will revolve in the opposite direction to expose the reduced charge curves. The change over takes place at zero rauge.

126. **Gun range** then drives from Plate 3, through to pinion F, pinion G, and the lower green train which drives—

(i) to range to elevation mechanism in Plate 5 ;
(ii) to the stop mechanism, and
(iii) continues to the cam in Plate 2, as before.

127. The ratio introduced between pinions F and G is this being the multiplier required to convert reduced charge to equivalent full charge range.

Note.—The function of the yellow member, which is driven by pinion H is to prevent the operation of the F.C.–R.C. mechanism change-over key at any range other than zero, at which position only is the tongue in the red splined clutch able to pass through the groove in the yellow member.

128. It will be appreciated that it is not possible to obtain absolute accuracy between reduced charge and equivalent full charge range throughout the working zone by the introduction of a multiplier. The errors introduced however are slight.

129–135.

RANGE TO ELEVATION UNIT

Plate 5

136. This plate gives two illustrations of the range to elevation conversion unit, one from above and one from below. Similar mechanism is found in all modern low angle fire control instruments, the principle upon which it is constructed being that tangent elevation corresponding to any given range can be determined from the appropriate range table and plotted to a range base. Equally, the graph so formed can be reproduced mechanically as a cam indicated by the steel pins projecting above the surface of the green disc, and so arranged, as the disc is rotated, to engage and turn the pinion (A).

To ensure that pinion (A) remains in mesh with the line of pins, as the disc rotates, it is carried upon a lead screw causing it to advance as it revolves. Pinion (A) drives pinion (B) which is sufficiently wide to remain in gear with pinion (A) throughout its travel across the disc.

137. **Gun range** from Plate 4 enters by the green coupling shown in the upper illustration and rotates the green disc. The pins in the disc revolve pinion (A) to the corresponding **tangent elevation.** Pinion (A) drives pinion (B) which transmits tangent elevation by the mauve bevel drive and coupling to mechanism in Plate 7.

138. The lower illustration shows the underside of the disc, the central bearing and the three rollers, in the fixed casing, upon which the disc revolves.

139. The drive to the pinwheel is such that it makes one revolution for each 10,000 yards of gun range, and a scale of ranges is engraved on the underside for use when assembling the unit. As a check that the path of the pins is that for the guns with which the instrument is to be used, the range corresponding to elevation is separately engraved. The range of 23,961 yards shown on the rim is the range to which the index should be pointing when 18° of elevation is being transmitted to the guns (other settings being at zero).

140—145.

OWN AND ENEMY DEFLECTION AND DEFLECTION SPOTTING MECHANISM

Plate 6

146. **Deflection due to own speed across the line of fire** from own ship resolver in Plate 1 enters by the red coupling and drive on the left of this plate, and by the vertical red spindle drives the red dial (the amount of this deflection showing on the graduated dial against the fixed index).

Note.—During this movement of the red dial the pale yellow pointer which is controlled by the pale yellow cage of differential (A) remains in line with the fixed index and does not move with the red dial.

The deflection indicated by the movement of the red dial away from the fixed index is then applied by turning the enemy follow handle until the pale yellow pointer is in line with zero on the red dial.

Note.—On the fire control box itself the pointer here described as pale yellow is coloured black. The zero of the red dial is referred to in the drill as the "red zero."

147. The orange drive of the enemy follow-up handle rotates through worm and wormwheel the upper hub of each of the differentials (A) and (B).

In differential (A), assuming the blue hub to be stationary, this drive is transmitted by the pale yellow cage and the pale yellow train to the pale yellow pointer, which is thus aligned with the zero of the red dial. In differential (B) assuming the green hub to be stationary, the orange drive representing a part of

gun deflection, is transmitted by the pale green cage and downward pale green train and rotates—

(i) the wheel carrying the pin, pale green, which enters slots in the pale blue wheel and so revolves it (see further below) ;
(ii) the drive to the gun deflection pointer in Plate 10 ;
(iii) through the horizontal pale green shaft, the couplings to the gun deflection counter in Plate 1 and to other mechanism in Plate 7 or 7*.

Note.—In the orange drive is an indent wheel and spring plunger holding the drive in quarter unit steps, also a ratchet stop gear, which is described below.

148. **Deflection due to target speed across the line of fire,** combined with the correction for drift at the range in use, is read off the drum shown in Plate 4 and set by the rim pointer, blue, on the outer scale of the right-hand dial in this plate, by pushing in and turning the enemy setting knob, blue.

Note.—On the fire control box itself the rim pointer here described as blue is coloured yellow.

149. The drive from this setting knob, through stop wheels which limit its movement to 40 units R. or L., revolves—

(i) the worm and wormwheel and vertical blue train setting the rim pointer ;
(ii) the lower hub of differential (A), and so through the pale yellow cage and pale yellow train moves the pale yellow pointer an equal amount to that of the rim pointer but in the opposite direction.

150. The deflection and drift indicated by the movement of the pointer, pale yellow, away from the zero of the dial is then applied by turning the enemy follow handle, until the pale yellow pointer is again in line with zero on the red dial.

151. The orange drive of the enemy follow handle rotates the upper hub of each of the differentials (A) and (B).

In differential (A) this drive is transmitted as before to the pale yellow pointer which is thus aligned with the zero of the red dial.

In differential (B) this drive representing the other parts of gun deflection is transmitted to—

(i) the wheel carrying the pin which revolves the pale blue stop wheel ;
(ii) the drive to the gun deflection pointer in Plate 10 ;
(iii) the gun deflection counter in Plate 1 and to other mechanism in Plate 7 or 7*.

152. Should it be desired to reject the change in the enemy correction (if, for example, a spotting correction producing this result has just been applied), the yellow pointer which is a fly-back pointer is returned to the zero of the red dial by pressing the recentring push.

153. **Deflection spotting corrections** are applied by the green deflection spotting handle whose drive—

(i) through the first green worm and wormwheel, sets the pointer and the rim pointer of the deflection spotting dial. The pointer is a fly-back pointer operated by a push on the green rocker arm by which it is returned to zero after each spotting correction has been made.

The sum of the deflection spotting corrections that have been made is represented by the position of the rim pointer.

Note.—On the fire control box itself the fly-back pointer is coloured black and the rim pointer is coloured blue.

(ii) through the second green worm and wormwheel enters the lower hub of the differential (B).

154. Here, assuming the orange hub to be stationary, the pale green cage transmits the spotting correction downwards through the pale green train—

(i) to the wheel carrying the pin which revolves the pale blue stop wheel ;
(ii) the drive to the gun deflection pointer in Plate 10 ;
(iii) the gun deflection counter in Plate 1 and to other mechanism in Plate 7 or 7*.

Note.—In the green drive is an indent wheel and spring plunger holding the drive in quarter unit steps, also a ratchet stop gear (see below).

Operation of the Geneva stop gear

155. The pale blue slotted wheel, which is referred to above as being revolved by the pin in the pale green train, itself carries a pin which at the deflection limits of the 80 units R. or L. Deflection strikes one or other side of the mauve lever (C) of the ratchet stop gear. This causes a partial rotation of the mauve links and brings into operation one or other of the pawls at the top of each mauve lever. These then engage the ratchet wheels on both the enemy follow and deflection spotting drives preventing further movement in the direction which brought the stop into action, but leaving the mechanism free to move in the opposite direction.

Note.—To hold the pawls in the open position, and the mauve levers central two spring plungers shown at the lower end of the right-hand lever operate on the mauve link.

156–160.

TRANSMISSION GEAR, F.C.B., MARK IV

Plate 7

161. **Gun elevation** is transmitted from the F.C.B. to the elevation receivers at the guns by two magslip transmitters. Director setting from the local layers sight is fed in from below by a mechanical drive from the sight via Plate 9, and drives the vertical pink shaft in the centre of the plate, the bevel wheel and horizontal shaft to the pink hub of a differential. Assuming the mauve hub to be stationary this drive is transmitted by the orange cage to the orange shaft passing through the differential. The left-hand side of this shaft drives direct to the fine magslip gun elevation transmitter and by reduction gear to the coarse magslip transmitter. The right-hand side of the orange shaft drives through the orange train to a mechanical gun elevation repeat on the side of the box.

162. **Tangent elevation** from the range to elevation unit Plate 5 enters by the coupling on the left and through the mauve train passes to the mauve hub of the differential. Assuming the pink hub to be stationary, this drive is transmitted by the orange cage to the gun elevation transmitters and to the gun elevation repeat.

163. **Gun training** from Plate 9 enters from below by the coupling and the vertical mauve shaft and drives

(i) the mechanical gun training repeat on the side of the box ;

(ii) the mauve hub of a differential, where gun deflection, pale green, is subtracted from it to produce line of sight training, pale blue, which is transmitted by the pale blue train to Plate 1.

164. **Gun deflection** from Plate 6 enters by the coupling on the right by the pale green shaft passes to

(i) the pale green shaft to the gun deflection transmitter by which it is transmitted to the O.O.T.'s position ;

(ii) out to Plate 9 ;

(iii) the pale green train to the pale green hub of the differential where it is subtracted from gun training, mauve, to produce line of sight training.

165. **Gun range** from Plate 3 enters by the coupling on the right and passes by the dark green bevel wheels and shaft to the gun range transmitter, by which it is transmitted to the O.O.T.'s position.

166–170.

THE CONVERGENCE MECHANISM AND TRANSMISSION GEAR, F.C.B., MARK IV*

Plate 7*

171. The Mark IV* F.C.B. transmits gun elevation and gun training to "A" and "Y" turrets in addition to gun elevation to its own ("B" turret) guns.

172. Gun training circuits are duplicated, one circuit running each side of the ship. This arrangement conforms with the wiring of the main director circuits. There are therefore two sets of transmitters to "A" and "Y" turrets.

173. Gun elevation transmission is not duplicated.

174. There are no gun range or gun deflection transmitters as the Mark IV* box is fitted in a specially arranged control officer's position, where the Control Officer can supervise the working of the box.

175. Convergence is applied to "Y" turret gun training only; the correction required for "A" turret being too small at normal ranges to warrant the introduction of the additional gear required.

176. **Director setting** from the local layer's sight is fed in from below by a mechanical drive from the sight via Plate 9 and passes by the vertical pink shaft and train to the pink hub of a differential.

In this differential, it is added to tangent elevation, mauve, and the resultant gun elevation is transmitted by the orange shafting to the fine magslip gun elevation transmitter to "B" turret, and by 1 to 1 gearing to the fine transmitters to "A" and "Y" turrets. From the drive to "Y" turret transmitter, a shaft, rigidly connected drives

(i) reduction gearing to the coarse gun elevation transmitters;
(ii) a mechanical gun elevation repeat on the side of the box.

177. **Tangent elevation** from the range to elevation unit, Plate 5, enters by the coupling on the left and through the mauve train passes to the mauve hub of the differential where it is added to director setting, pink, to produce gun elevation, orange.

178. **Gun training** from Plate 9 enters from below by the coupling and the vertical mauve shaft and drives

(i) the mechanical gun training repeat on the side of the box;
(ii) the mauve hub of differential B;
(iii) the mauve hub of differential C;
(iv) the upper (mauve) disc of the convergence gear;
(v) the gun training transmitters to "A" turret.

In differential B gun deflection, pale green, is subtracted from gun training, mauve, to produce line of sight training, pale blue, which is transmitted to Plate 1 for the resolving mechanism.

In differential C, the convergence, blue, for "Y" turret is added and the resultant "Y" turret training, red, is used to drive the coarse and fine magslip transmitter.

The upper disc of the convergence gear is revolved by the vertical mauve shaft from the gun training drive. Turning the mauve disc will cause the lower (mauve) hub of differential D to turn. Assuming the dark green hub stationary the drive is transmitted by the pink cage to the pink pinion and so turns the lower disc an equal amount to the upper disc. Therefore both discs revolve together for training.

179. **Gun deflection** from Plate 6 enters by the coupling on the right and by the pale green shaft passes to

(i) out to Plate 9 ;

(ii) the pale green hub of differential B where it is added to gun training, mauve, to produce line of sight training.

180. **Gun range** from Plate 3 enters by the coupling on the right and passes by the dark green train to—

(i) the upper member of differential D ;

(ii) the mechanical stop gear.

In differential D, assuming the mauve hub stationary, the drive is transmitted to the pink cage and pink pinion to the lower disc of the convergence gear, thus moving the lower disc relative to the upper.

181. Mechanical stop gearing is fitted to the gun range drive to limit the movement between slightly under 0 and slightly over 25,300 yards. This stop is to prevent damage to the cam pin on the convergence gear when the instrument is opened up and the gun range coupling, green, turned by hand. When the instrument is closed the stop gear on Plate 4 operates and so prevents any damage to the cam pin. A nut travelling on the vertical lead screw forms a positive stop at either end of its travel. The nut is prevented from turning by an extension which travels in a slot in the frame work and forms an index pointer for reading against a range scale.

182–185.

THE CONVERGENCE MECHANISM

Plate 8

186. The convergence mechanism is designed to correct the gun training transmission to " Y " turret only, and is not adjustable for any other displacement distance. This fixed distance, 313 ft., is allowed for in the cam groove cut in the lower disc.

187. The amount of correction required varies therefore with range and bearing.

188. The mechanism consists of two discs, the upper (mauve) disc carrying a slider between two guides. A pin from the slider passes through a slot in the upper disc into a cam groove in the lower (pink) disc. It will have been noted from paragraph 180 that when gun range is moved the lower disc is revolved relative to the upper.

The cam therefore causes the slider to move out from the centre of the upper disc. A second pin attached to the top of the slider is connected to a sliding block moving in a slot in the convergence rack. This rack, dark blue, can move across the fixed frame. As gun training alters, both discs revolve together (*see* paragraph 178) carrying with them the pink slider and thereby moving the blue rack and pinion. This movement of the blue pinion is transmitted by the blue shaft to differential C, Plate 7*, where it is added to gun training, mauve, to produce " Y " turret training, red.

189. An index pointer is fitted, against which the zero range and zero bearing marks on the discs are aligned when assembling or checking.

190. The convergence correction is accurate from 2,000 to 25,000 yards.

THE INCOMING AND OUTGOING MECHANICAL DRIVES, MARKS IV AND IV*

Plate 9

195. **Gun training** is fed into the F.C.B. from below by a mechanical drive taken direct from the turret training rack. As the turret is trained, a pinion engaging in the turret training rack walks round the rack and so revolves the vertical mauve shaft and passes by the mauve coupling to Plate 7 or 7*. The F.C.B. must be so positioned in the turret that this shaft is in correct alignment with its lower driving pinion.

196. **Director setting** is fed in mechanically by shafting from the local layers sight on to the pink coupling, and by the pink train passes to Plate 7 or 7*.

197. **Gun deflection** from the fire control box enters by the coupling on the right and passes by the pale green train to shafting in the turret which connects with the local trainers sight and offsets his sight by the amount of deflection.

198. The coupling shafts in the F.C.B. for director setting and gun deflection are adjustable laterally, in order that they may be aligned with the turret shafting when putting the box in the turret. These two shafts are carried in a casing which is pivoted at its inner end and secured by a clamping nut, yellow. At the outer end is a locking bolt, which may also be used as a sighting pin for lining up the shafts. By easing up the clamping nut and the locking bolt, the casing carrying the shaft may be pivoted until it is in line with the turret shafting.

199. Vernier couplings are fitted to both incoming and outgoing drives to enable the F.C.B. to be accurately lined up with the turret for training and, with the local sights, for director setting and deflection. Having once been lined up on assembly, these vernier couplings should not require any further attention.

Note.—The gearing in the F.C.B. is so designed that the torque on the incoming director setting drive should not exceed 5 lbs./in. The torque on the shafting in the turret to the trainers local sight for gun deflection should not exceed 20 lbs./in. If the effort to turn this external shafting exceeds this amount, considerable strain is brought on the gearing in the deflection train in the F.C.B. and may damage the gearing.

200. In F.C.B., Mark IV*, the arrangement of the training drive is slightly different from that in F.C.B., Mark IV.

201–205.

THE GUN RANGE AND GUN DEFLECTION DIALS

Plate 10

206. So that the fire control box may be kept tuned to the latest and most accurate data whilst the main control is functioning, gun range and deflection are transmitted electrically to the box from the A.F.C.T. in the T.S. By keeping the fire control box tuned to this range and deflection, any turret will be ready to continue firing in local control at a moment's notice with the up-to-date range and deflection set.

207. **Gun range from the T.S.** is received electrically by the Mark III, " M " type motor on the right and passes by the mauve train to a central vertical spindle carrying a pointer which moves round the inside of the dial.

A continuation of the mauve shaft drives a second pointer which shows on the outside of the dial. In the fire control box itself these two pointers are coloured red. The gearing is so arranged that the outer pointer makes eight revolutions to one revolution of the inner pointer. One revolution of the outer pointer is equivalent to 6,000 yards. The dial is graduated on the outer circumference from 0 to 6,000 in 200 yard divisions and on the inner circumference from 0 to 48,000 in 6,000 yard divisions.

208. **Gun range** from Plate 3 drives the green shaft and train through similar gearing to two green pointers. In the fire control box these two pointers are coloured black.

209. **Gun deflection from the T.S.** is received electrically by the Mark III " M " type motor on the left and passes by the orange train to the orange pointer on the deflection dial. This is a red pointer in the F.C.B.

210. Gun deflection from Plate 6 (or 7 or 7*), drives the pale green train and pale green pointer on the outside of the dial. This pointer is black in the F.C.B.

211. By aligning the black pointers with the red the fire control box is kept set to the same gun range and deflection as that on the A.F.C.T.

212. Each " M " type motor is fitted with a lining up handle, for lining up the red pointers by hand.

Note.—Stop gear in the gun range drive comes into operation at 25,000 yards. It is not possible, therefore, to keep the gun range pointers in line at ranges in excess of this.

213.

Plates 11 and 12

214. The whole of the mechanism and gearing in the fire control box, Marks IV and IV*, are shown in these plates.

Figures adjacent to shafts are rotational values per turn and figures on gear wheels are numbers of teeth or ratios between pairs of gears.

Figures adjacent to racks and slides indicate value per inch of linear movement.

215–216.

WIND DEFLECTION CALCULATOR

Plate 17

217. This is a hand instrument designed to give the deflection required for true wind. The instrument is extremely simple to use, viz. :—

(1) Set the range of the enemy against the wind force or speed by moving the wind bar.

(2) Point the black arrow of the instrument at the target.

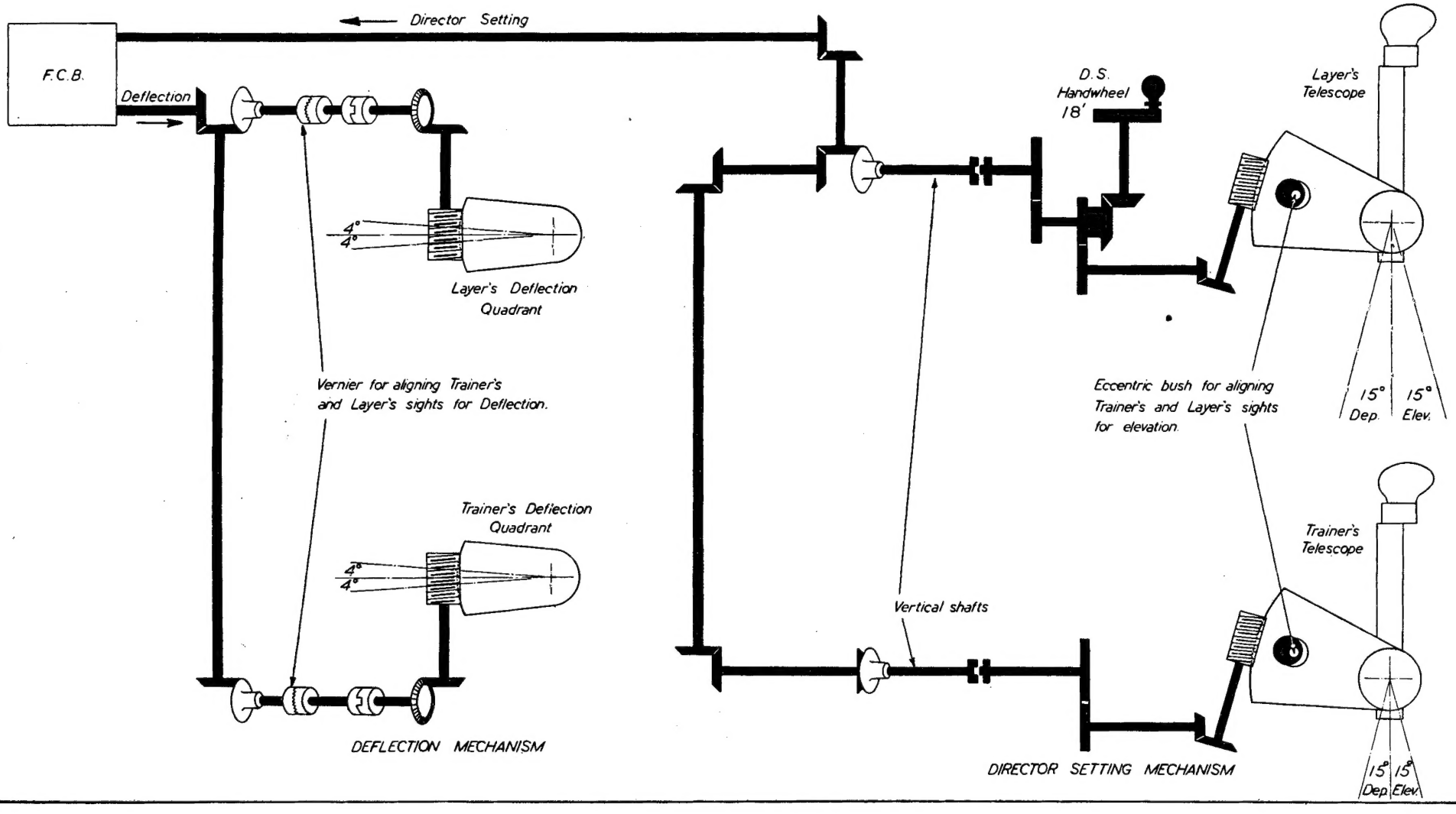
(3) Set the wind bar parallel to the true wind with the arrow on the wind bar pointing in the direction of the wind (*i.e.*, with the pointed end of the wind bar pointing into the wind).

(4) Read off the deflection required at the pointed end of the wind bar and apply as a deflection spotting correction.

218. The design of the deflection scale is only accurate down to 2 units, as the scale is a logarithmic one. There are many combinations of low wind speed and low ranges which give a deflection of less than 2 units and it is possible that a deflection can be produced in the wrong direction, as the pointed end of the wind bar will then be on the wrong side of the centre line. Therefore, if the pointer on the wind bar indicates a deflection of less than 2 units in the expected direction (*i.e.*, left if the wind is from the left) then the result should be disregarded, and the necessary deflection estimated.

219. The Plate illustrates the Wind Deflection Calculator suitable for 4-in., Mark XVI gun. A similar instrument, Pattern 10045, is supplied for use with Marks IV and IV* boxes for the 14-in. B.L., Mark VII, gun and differs only from that illustrated in the graduation of the wind bar.

DIAGRAMMATIC ARRANGEMENT OF THE FIRE CONTROL BOX & THE TURRET SIGHTS



CHAPTER V

THE FIRE CONTROL BOX AND THE TURRET SIGHTS

(See diagram on the opposite page.)

260. Each turret contains a layer's sight and a trainer's sight.

The layer's sight transmits director setting mechanically to the trainer's sight and to the fire control box.

The fire control box transmits deflection mechanically to the layer's sight and to the trainer's sight.

The trainer's sight receives turret training mechanically from the turret training rack on coarse and fine dials, and transmits it electrically to training tell-tales at O.O.T.'s position and to the transmitting station ("B" turret only) with local repeat pointers in the receiver on the sight.

Plate 15

261. This plate shows in plan the position of the two sights relative to the fire control box and the connecting shafting, also, in elevation, the layer's sight relative to its sighting port and to the gun trunnions.

GENERAL ARRANGEMENT OF THE LAYER'S SIGHT AND OF THE TRAINER'S SIGHT

Plate 16

Layer's sight

262. This plate shows, coloured blue, the director setting handwheel and its drive to a worm and quadrant by which the telescope carrier is moved in elevation, and the drive outwards to the trainer's sight and to the fire control box. The director setting handwheel contains stop pawls which operate at 15° elevation and 15° depression.

It also shows, coloured yellow, the worm, mechanically operated from the fire control box by which the upper part of the sight is rotated in azimuth according to the deflection that is being calculated in the fire control box.

Adjustment for elevation.—The quadrant is in two parts, one of which carries the telescope holder, the other the wormwheel sector. Adjustment between them is provided by means of a bolt operating in an eccentric bush. Access to this adjustment is obtained by removing a circular cover plate engraved "Remove cover to align telescope for elevation."

Adjustment for line.—There is a vernier coupling in the deflection worm drive.

Anti-backlash arrangements.—Both the elevating worm and the deflection worm are split.

Trainer's sight

263. Here, coloured blue, is shown the drive to the worm and quadrant operated by the cross connection, and moving the trainer's telescope carrier in elevation.

Also, coloured yellow, is the worm driven by the cross connection shaft from the fire control box, by which the upper part of the sight is rotated in azimuth in parallel with the layer's sight.

The drive of turret training is shown in red entering the training receiver (E.M. Mark I*) where it shows on the dials and operates two transmitters as already stated (*see* paragraph 260).

Adjustments for elevation and for line and anti-backlash arrangements are the same as in the layer's sight.

There is a vernier coupling in the drive from turret training rack for aligning the mechanical pointers in the training receiver.

Note.—There is in each sight a rotational (epicyclic) error due to the fact that setting the deflection causes a movement in elevation, amounting to 0·53 minutes of elevation at maximum deflection. This is accepted.

Lubrication

264. An oil reservoir at the top of each sight supplies all gears and bearings by copper pipes 0·15-in. in diameter.

An oil reservoir vertically above the deflection worm supplies oil to the worm and wormwheel and from the worm casing by an internal oil pipe to the gears and bearings in the lower part of the elevation drive.

The trainer's sight has an additional oil well to lubricate the train of gears leading to the training receiver and transmitters.

DATA AND LIMITS OF THE FIRE CONTROL BOX, MARKS IV AND IV*, WHEN USED WITH THE 14-IN., MARK VII GUN

Range rate is indicated against a scale, on top of the box, 0 to 2,400 yards per minute opening and closing.

Range tuning and spotting by handle on right-hand side of box, spotting shown on a dial with fly-back pointer. Scale 0–2,000 yards " up " and " down."

Gun range indicated on drum counter to the nearest 50 yards. Range 0 to 25,380 yards.

Gun range follow the pointer dial.—Dial with mechanical pointer and electrical repeat pointer. Outer pointer 0 to 6,000 yards, inner pointer 0 to 48,000 yards (50 yard steps).
Mechanical stop on " follow handle " at 0 and 25,380 yards.

Full and reduced charge.—The charge change clutch on left-hand side of box is marked full charge and reduced charge. In the reduced charge position approximately the correct reduced charge tangent elevation for the range set is applied.

For sub-calibre, the charge change clutch is set to full charge. Equivalent F.C. ranges are used. The equivalent F.C. ranges corresponding to the actual range are shown on a plate on the top of the fire control box and in column 2 of the table at the head of page 36.
Sub-calibre R.T. No. 177.

Range to elevation gear R.T. 415. Maximum range 25,380 yards (elevation 19°—43 ft.).

Own ship deflection dial 0 to 40 units right and left.

Enemy deflection and drift scale 0 to 40 units right and left.

Enemy deflection and drift drum 0 to 26 units left, 0 to 16 units right.

The deflection and drift drum is engraved with curves for " F.C." and " R.C." firing.

Gun deflection counter 0 to 40 units right and left graduated to nearest ½ unit.

Deflection spotting by handle on left side of box. Spotting shown against a separate dial, calibrated to 20 units left and right and with a fly back pointer. Total spotting up to 40 units left and right is shown against outer scale of dial.

Gun deflection follow the pointer dial.—Dial with mechanical pointer and electrical repeat pointer (¼ unit steps). Pointers 0 to 40 units left and right.

Gun training by mechanical shaft direct from turret rack , one revolution = 15° of training (vernier coupling). Mechanical repeat dial, less convergence, for lining-up purposes on side of box.
Outer pointer 0 to 180° green and red.
Inner pointer 0 to 10°.

Line of sight dial on side of box for lining up purposes.
Outer pointer 0 to 180° green and red.
Inner pointer 0 to 10°.

Director setting by mechanical shaft direct from turret local sight one revolution = 2° of elevation (vernier coupling).

Gun elevation dial mechanical repeat dial on side of box for lining up purposes.
Outer pointer 10 to 90°.
Inner pointer 0 to 10°.

Gun deflection by mechanical shaft to turret local sights one revolution = 2° (vernier coupling). Stops are provided to outgoing mechanical shaft to limit the sum of the " follow " and " spotting " handles to 40 units left and right.

Fire gong push carried at end of box.

Own speed setting up to 30 knots.

Enemy speed setting up to 40 knots.

Constant speed motor 1/30 H.P., complete with governor, resistance and switch.

*Transmission unit for Mark IV**

Gun training contains two pairs 2-in. magslip transmitters, 360° and 5°, for duplicate wiring to " A " turret and two pairs 2-in. magslip transmitters, 360° and 5°, for duplicate wiring to " Y " turret, the latter pair includes the convergence correction.

Convergence gear is provided to converge " Y " turret to " B " turret.

The base length of 314 ft. gives true convergence from 2,000 yards to 20,000 yards. Range for no convergence, 25,000 yards. A coarse range indication appears on the outside of the transmission unit for lining-up purposes after the box has been opened.

Gun elevation.—Three pairs 2-in. magslip transmitters, 120° and 5°, to own guns. " A " and " Y " turrets, in " B " turret mechanical repeat dial.

Transmission unit, Mark IV

Gun training.—No electrical transmission.

Gun elevation.—One pair of 2-in. magslip transmitters, 120° and 5°, via C.O.S. to own guns for " A " and " Y " turrets.

Gun range.—Mark VI, " M " type transmitter, 50-yard steps, to counterdrum repeat at Control Officer's sight.

Gun deflection.—Mark VI, " M " type transmitter, ½ unit steps, to counterdrum repeat at Control Officer's position.

ERRORS IN DEFLECTION WHEN FIRING 6-PDR. SUB-CALIBRE

True Range.	E.F.C. Range.	No Speed across, *i.e.*, Inclination 180°.	5 knots S.P. across.		10 knots S.P. across.	
			R.	L.	R.	L.
1,000	2,403	0·06R	1·3L	1·4R	2·7L	2·8R
2,000	5,653	0·1R	1·6L	1·7R	3·3L	3·4R
3,000	9,446	0·2R	1·7L	2·1R	3·6L	4·0R
4,000	13,530	0·4R	1·8L	2·5R	4·0L	4·7R
5,000	17,680	0·55R	1·85L	3·0R	4·3L	5·45R
6,000	21,895	0·65R	2·0L	3·25R	4·6L	5·85R
6,500	24,056	0·85R	2·0L	3·6R	4·7L	6·3R

The above errors are in units and show the direction of the error of the fall of shot.

CHARGE CHANGE REDUCTION GEAR—DATA

Gun.	M.V.	R.T.		M.V.	R.T.	Ratio.
14-in., B.L., Mark VII, F.C.	2,400	415	Reduced charge	2,000	419	1·3636 : 1

R TO E GEAR—DATA

Gun.	M.V.	R.T.	Maximum Range.	Corresponding Elevation.	Range corresponding to One Revolution of Pinwheel.
14-in., B.L., Mark VII, F.C.	2,400	415	25,380	19° 43′	10,000

VARIABLE SPEED MECHANISM

The Ranges at which the Cam operates to lift the Generating Roller off the Topmost Ball.

14-in., B.L., Mark VII	F.C.B., Marks IV and IV* ..	200 yards and 25,200 yards.

Weight

Of the fire control box, Mark IV .. .. lbs.
,, ,, ,, ,, Mark IV* .. .. lbs.